2.0 CRANE MOUNTAIN LANDFILL

2.1 Location

The Crane Mountain Landfill is in the northwestern part of the City of Saint John and is located along Highway 7, adjacent to the Route 177 exit to Martinon and the Town of Grand Bay-Westfield. Grand Bay is approximately 5 km northeast of the landfill and Martinon is approximately 4 km northeast of the landfill. Other communities in the immediate area include Morna, Morna Heights, Belmont, Ketepec, Acamac and South Bay, all located along the Saint John River approximately 4 to 5 km east of the landfill. Figure 2-1 shows a location plan for the landfill.

Figure 2-2 is an aerial photo of the landfill looking northeast towards Martinon and Grand Bay.

2.2 Geological/ Hydrogeological Setting

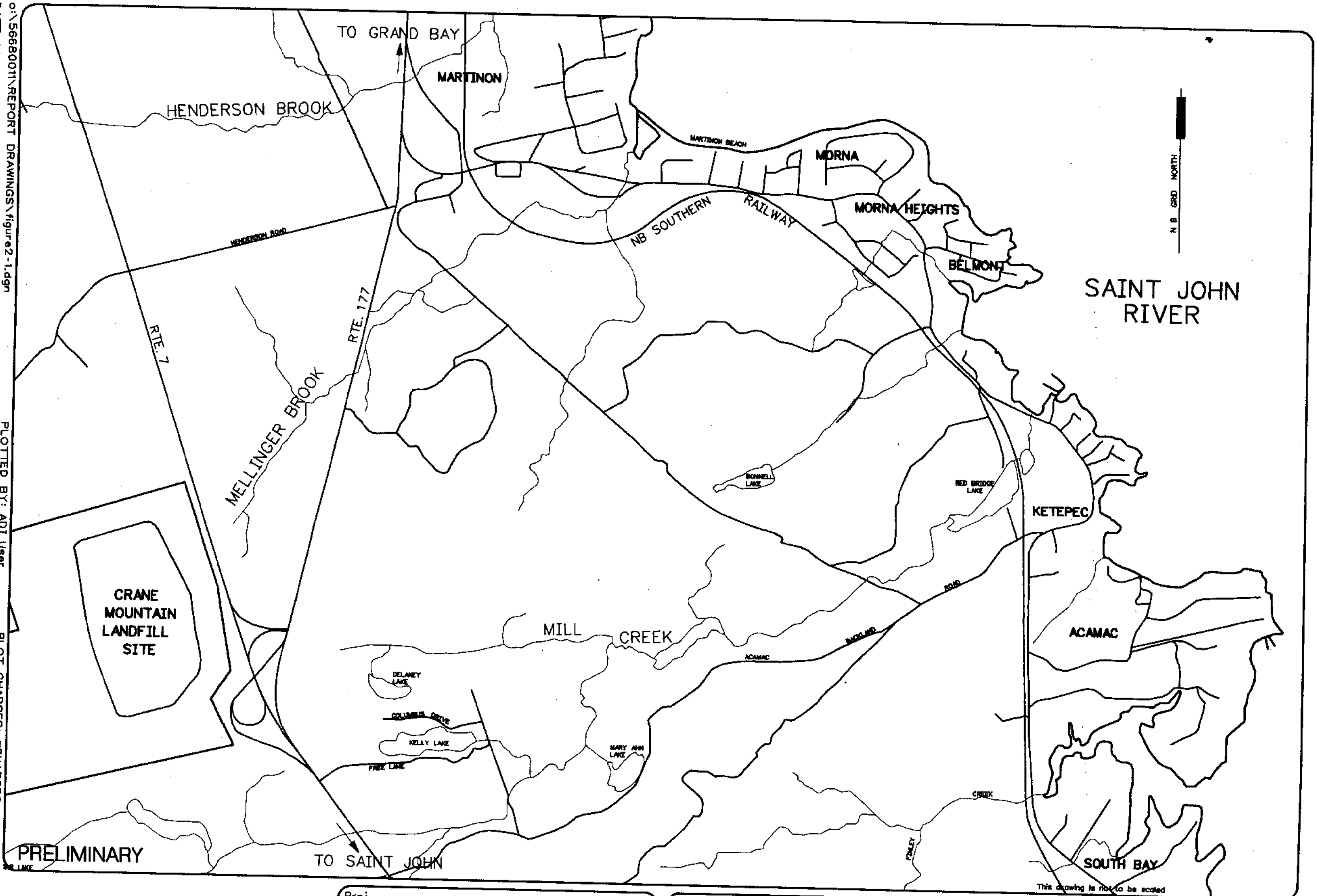
Background information regarding site setting has been provided in EIA documentation prepared for the site, and the related report (Gemtec, 1993) *"Selection of a Sanitary Landfill Site for the Fundy Region Detailed Site Investigation Crane Mountain (Gemtec Limited, File 20658.01, December 1993)"*. A summary of information follows.

Physiography, Topography and Drainage

The Crane mountain site is located in the eastern part of the Musquash Lowlands, described as an undulating plain with isolated clusters of hills bordering the Bay of Fundy (Rampton, 1984). The Musquash Lowlands are a subdivision of the St. Croix Highlands.

The site is characterized by flat to gently rolling topography with elevations ranging from a low of elevation 62 to a high of elevation 100 m above sea level. Drainage is to the east towards Mellinger Brook. Topographic gradient of the general site area is in the range 4 to 12 %, with regional topographic gradient of approximately 3%.

The site is located approximately 4 km east of the Saint John River, and primarily within the drainage basin of Mellinger Brook that flows eastward and discharges into the Saint John River at Martinon Beach. This drainage basin is bounded to the west by Henderson Lake, and to the north by Henderson Brook (flows out of Henderson Lake). The southern edge



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Proj. INDEPENDENT EXTERNAL REVIEW OF CRANE MOUNTAIN LANDFILL	Dwg. LOCATION PLAN	Drawn By: OSE	Proj. No. 5668-001.1
		Dwg Standards Chk. By:	Dwg. No. FIGURE 2-1
		Designed By: TKO	Dwg Design Ckd By: — Rev. 0

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Aerial Photo of Crane Mountain Landfill Figure 2-2

of the site is near the drainage divide of Mill Creek. Carr Lake and Ghost Lake form the headwaters of Mill Creek which flows east and discharges into the Saint John River at Ketepec. In general, overall drainage for the site is to the east, where surface water would discharge to the Saint John River at Martinon Beach via Mellinger Brook that drains the small watershed in which the landfill is located.

Geology

Surficial Geology - Overburden geology consists generally of a thin root mat and layer of surface organics overlying glacial deposits. The glacial deposits are mapped regionally as a blanket of loamy lodgement till, minor ablation till, silt, sand, gravel and rubble varying in thickness from 0.3 to 3 m. (Till is defined as predominantly unsorted and unstratified drift, generally unconsolidated, deposited directly underneath a glacier without subsequent reworking by meltwater, and consisting of a heterogeneous mixture of clay, silt, sand, gravel, and boulders ranging widely in size and shape, *Groundwater and Wells, Johnson Filtration Systems Inc, 1986*). Results of test pits and boreholes completed as part of the site characterization process indicate in general 0.2 m to 0.5 m of organics and silt overlying a lodgement till. The till stratum generally includes a medium dense till observed to overlie a dense to very dense till, with till thickness ranging from 4.6 m to 14.0 m thick over the south half of the Crane Mountain site. In the north half of the site the thickness of the till drops to 1.2 m to 2.4 m in some areas.

The fine grained fraction (silt and clay) for the till was in the range 30.6 to 51.5 %, and averaged 37 % silt and clay (16 % as clay size), with the till classified as silty sand with low plasticity fines. Hydraulic conductivity of remolded till samples was typically on the order of (3×10^{-10} m/s). (Hydraulic conductivity is defined as the rate of flow of water through a unit cross-section under a unit hydraulic gradient. In the metric system, the units are $m^3/day/m^2$ or m/day (or m/s), *Groundwater and Wells, Johnson Filtration Systems Inc., 1986)*. This value is considered relatively low, although as noted in site characterization documentation (e.g. Gemtec, 1993), *"....field scale hydraulic conductivity is likely controlled by the presence of cracks or fissures within the till, and as such, may be considerably higher than that applicable to the remolded samples."* An average in situ hydraulic conductivity value of 2×10^{-7} m/s was cited based on three field tests.

Bedrock Geology - Regional bedrock geology in the area includes the Cambrian Age Milkish Head Pluton, with rock types including grey quartz diorite and tonalite gradational to pink granodiorite. Bedrock to the south of the site includes Ashburn Lake Formation metasediments of Cambrain to Pre-Cambrian Age, comprised of marble, orthoquartzite, minor sandstone and marble-sandstone conglomerate.

Bedrock underlying the site is predominantly pink granite and greenish granodiorite/ granite with some mafic volcanic and/or metasediment (summarized in Figure 5.1, Gemtec, 1993). Hydraulic conductivity for three boreholes reported in the detailed site characterization report (Gemtec, 1993) were 2.4×10^{-6} m/s (BH16S), 8.6×10^{-7} m/s (BH17S), and 5.6×10^{-6} m/s (BH17D).

The EIA report noted bedrock to be fractured, with fracturing described variably as "highly fractured" to "numerous fractures". No major structural discontinuities were reported based on the EIA site characterization work. Additional information and comments on bedrock geology was provided in a review paper (Fracflow Consultant Inc., 1997) of the EIA. According to this review, bedrock at the site is highly fractured, with observation from outcrops suggesting at least three to four sets of fractures; one set essentially subhorizontal, and three subvertical in orientation.

Hydrogeology

Site Hydrogeology - The detailed site characterization report (Gemtec, 1993) described groundwater flow at the site as consisting of a shallow system in the loose and thin near surface soils perched above the less permeable, silty glacial till. Flow direction(s) in this system are governed by variations in the surface of the till which was reported to loosely resemble surface topography. The shallow bedrock groundwater flow system was interpreted to be generally east north east, generally coincident with topographic slope (see Figure 5.1, Gemtec, 1993). Downward gradients were generally observed indicating recharge conditions; this is expected given the location of the site in the upper reach of the drainage basin.

Comment on Hydrologic Setting - The landfill site is located in the upper reach (recharge area) of the Mellinger Brook watershed, and is within proximity to the upper reach of the Mill Creek watershed located south of the site. In general, groundwater recharges in upland areas and discharges at the lower reach of a drainage basin. Depending on various factors (e.g. relative size and topographic configuration of a drainage basin) shallow, intermediate, and deeper groundwater flow systems can be present within a given watershed. In general, the deeper groundwater flow system is characterized by recharge in the upper reach, flow to depth, and discharge at the lower reach of the drainage basin, with intermediate and shallow flow systems superimposed on the deeper system depending on topography, geology, etc.

A general comment concerning site specific hydrogeological characterization provided in the detailed characterization report is the generally shallow depth of bedrock penetrated in bedrock boreholes and monitoring wells. Additional boreholes and monitoring wells have been installed as part of the groundwater monitoring system. It is recommended that the collective database be reviewed and documented in the context of an updated hydrogeological characterization report for the site. The review should include consideration of such factors as hydraulic conductivity; fracture distribution and frequency; flow gradients, directions, and velocities; groundwater chemistry; and consideration of site hydrologic setting in the context of shallow, intermediate and deeper flow systems.

Regarding the site being located in the recharge area of the drainage basin, it is acknowledged that in the context of potential impacts on the deeper flow system(s), the landfill liner hydraulic barrier is expected to provide a relatively high level of protection, in addition to the site specific natural mitigative attributes. Discounting the liner system underlying the waste material, site specific mitigating factors to assist in minimizing or eliminating the potential for groundwater impacts in the event of leakage include the presence of low permeability overburden deposits (glacial till) which are anticipated to result in a significant portion of incident waters to runoff by overland flow, or as a component of local shallow and or intermediate groundwater flow within the upper reach of the drainage basin. The dense to compact nature of the till and relatively high proportion of fines is also anticipated to provide additional natural protection to the underlying bedrock. However, as noted in the site characterization report work, preferential pathways can potentially be present through low permeability tills. Where present, such pathways can lower the natural protection typically provided by otherwise fine grained low permeability overburden.

2.3 Facilities

Operation of the Crane Mountain Landfill began in November 1997. The following summarizes the key components of the engineered landfill:

- Sedimentation ponds and treatment system (1997)
- Cell # 1 c/w leachate collection and extraction system (1997)
- Cell # 2 c/w leachate collection system connecting to Cell #1 (1998/99)
- Cell # 3 c/w leachate collection and extraction system (2002/03)

- Cell # 4 c/w leachate collection system connecting to Cell #3 (2004/05)
- Zenon leachate treatment system (decommissioned)
- Organic waste compost facility (2001)
- Construction and Demolition debris waste site (2002)
- Surge Pond (2004)
- Closure of the sideslopes of Cell #1 and Cell #2 (1999 & 2001)

For reference, the following is a list of the initial construction contracts issued during the construction of the landfill.

Tender 97-01	Site Clearing
Tender 97-02	Supply of Clay
Tender 97-03	Supply of Bentonite Amended Soil
Tender 97-04	Construction of Soil Liner Test Pads
Tender 97-05	Site Work - Phase 1
Tender 97-06	Site Work - Phase 2
Tender 97-07	Ancillary Buildings & Scale
Tender 97-08	Containment Cell #1
Tender 97-09	Site Work - Phase 3
Tender 97-10	Highway Interchange Upgrade
Tender 97-11	Office / Maintenance Buildings
Tender 97-12	Leachate Sewer
Tender 97-13	Off Site Landscaping & Visual Buffers
Tender 97-14	Commercial Laboratory Services
Tender 97-15	Leachate Pre-Treatment

A partial list of some of the subsequent larger expansions included the following.

Contract 98-07	Site Grading and Berms
Contract 98-08	Supply of Clay
Contract 98-09	Supply of Clear Stone
Contract 98-10	Containment Cell #2
Contract 98-11	Raising of North Berm @ Cell 1
Contract 98-12	Supply and Installation of Geosynthetics - Raising of North Berm
2000	Compost Facility (opened in July 2001)

Tender 00-01	Construction of Cover Lysimeters
Tender 00-02	Cell #3 - Lower Subdrains
Tender 00-11	Supply and Placement of Frost protection Material (Cell #3)
Contract 01-02	Containment Cell #3
Contract 01-03	Cell #3 Grading and Berms
Contract 01-04	Supply of Clear Stone
Contract 01-05	Cell #3 Pumps and Forcemain
Contract 01-06	Final Cap - Side Slope Cell #2 and Cell #1 Lysimeter
Contract 04-02	Leachate Surge Lagoon (Civil Package)
Contract 04-04	Leachate Surge Lagoon (Mechanical & Electrical Package)
Contract 2005-1	Containment Cell #4
Contract 2005-2	Supply of Clear Stone, (Cell #4)
Contract 2005-3	Supply of Clayey Material (Cell #4)

2.4 Operations

The Crane Mountain Landfill has several components and operations. These are shown in the overall landfill plan, Figure 2-3 at the back of the report.

The facilities at the landfill include the following:

- solid waste disposal cells
- leachate surge pond
- leachate collection system complete with three pump stations
- construction and demolition debris disposal site
- organic waste composting facility
- surface water sedimentation ponds

This review will focus on those facilities highlighted in FFEBC's objectives and specifications.